Effect of STCR based application of organic and inorganic fertilizers on growth, productivity and economics of wheat *(Triticum aestivum L.)* in Inceptisol of Prayagraj

ABSTRACT

A field experiment was carried out during Rabi season of 2020-2021 and 2021-2022 at the Sam Higginbottom University of Agriculture, Technology& Sciences, Prayagraj research field out the "Effect of STCR based application of organic and inorganic fertilizers on growth, productivity and economics of wheat (*Triticum aestivum L.*) in Inceptisol of Prayagraj". The excavated soil sample from experimental site before conducting research operation, mentioned that, soil is of sandy loam texture with neutral in soil pH (7.4), electrical conductivity was (0.34), organic carbon content (0.79%), medium available N (258.92 $kgha^{-1}$), available P(29.55$kgha^{-1}$) and available K(300.39$kgha^{-1}$). Among nine treatments, during field experimentation, the conjunctive use of farm yard manure, together come with best results. However, the growth factors including pre-harvest parameters(like plant height, number of green leaves $plant^{-1}$,number of tillers $plant^{-1}$,dry weight $plant^{-1}$) which was observed at 30,60,90 and 120 DAS,opined significantly highest in treatment(T9) registering STB+FYM 15 t ha^{-1} (150:15:150 NPK kg ha^{-1})+FYM 15 t ha^{-1},which is turn influenced in achieving highest mean of 1000 seed test weight(46.76 g),which ultimately gave the highest cumulative mean of grain yield(6.5tha^{-1}),straw yield (7.8tha^{-1}),NPK uptake in wheat grain(70.87 $kgha^{-1}$,20.65 $kgha^{-1}$ and 22.67 $kgha^{-1}$)and straw(33.05 $kgha^{-1}$,11.03 $kgha^{-1}$ and 92.35 $kgha^{-1}$),net return of 44922(₹ ha^{-1}),wider B:C ratio(1.84)as compared to rest of treatments. physical soil parameters, particle density(2.65Mgm^{-3}) with reduced bulk density (1.11 Mgm^{-3}) and low soil pH (7.35), low electrical conductivity (0.29dSm^{-1}), high available N (258.92 $kgha^{-1}$), high available P (30.08 $kgha^{-1}$) and high available K (300.39$kgha^{-1}$). The integrated use of NPK fertilizers with FYM based on STCR approach not only gave higher wheat yield but also improved soil properties and soil fertility.

Key words: Wheat crop, STCR, Integrated plant nutrients and soil properties

1. Introduction

In India, Uttar Pradesh (32.59 million tons) is highest producer of wheat followed by Madya Pradesh (19.61 million tons), Punjab (17.57 million tons) etc.

(Agricultural Statistics at a Glance,2020).

Wheat has been described as "Staff of life or king of cereals" and one of the most important staple food crops. Wheat has its own outstanding importance as a human food; it is rich in carbohydrates and protein. Wheat is cultivated in at least 43 countries of the world. The leading countries in wheat cultivation are China, India, Thailand, Indonesia and U.S.A. and total production of wheat was 647 million tons under area of 218 million hectares with productivity of 2960 kg ha^{-1}. (FAO, 2012**).**

Developed the methodology of soil test based nutrient recommendation for targeted yield. It is a more quantitative, precise and meaningful approach because it involves combined use of soil and plant analysis, which provide information on real balance between applied nutrient and available nutrients of soil. (Rama Moorthy *et al*.,1967).

Soil Test Crop Response (STCR) STCR approach provides the balanced supply of required quantities of nutrients to the crops thus avoiding the over and under usage of fertilizers. This prevents the environmental hazards and results in higher returns. Crop requirements are satisfied to produce the highest economic yields, ensure the quality of the produce and avoid excessive levels of nutrients (Boldea *et al*., 2015).

The STCR approach reach out to farmer through saving of fertilizer nutrient and a desired yield can be opted as per economic condition of farmers (Bhatt *et al.*,2021).

Objectives:

1. To study integrated use of chemical fertilizer and FYM on growth and yield of wheat.
2. To evaluate the best treatment for wheat crop.
3. To calculate benefit cost ratio(B:C), of different treatment combination of wheat.

2. MATERIALS AND METHODS

The field experiment was conducted during the rabi season 2020-2021 and 2021-2022, in Soil Science Research farm of Department of Soil Science & Agriculture Chemistry, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, (U.P.).

EXPERIMENTAL SITE

The experiment will be conducted at research farm of Department of Soil Science at Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj the area is

situated on the South of Prayagraj on the right side of the river Yamuna on the South of Rewa road at a distance of about 6 Km from Prayagraj city. It is situated at $25^0$24'30" N latitude, $81^0$51'10" E longitude and 98 meter above the sea-level.

CLIMATIC CONDITION

Argo- climatically, Prayagraj District represents the subtropical belt of the South East of Uttar Pradesh, and is endowed with extremely hot summer and fairly cold winter. The maximum temperature of the location ranges between 46^0C and seldom falls below 4^0C-5^0C. The relative humidity ranges between 20-94%. The average rainfall of this area is around1100 mm annually.

COLLECTION OF SOIL SAMPLE

The Soil sample were collected randomly from depth 0-15 cm and 15-30 cm depth from 5 spots of the experimental farm just before layout of experiment. The experiment was analyzed for physical and chemical properties, after air dried and passed through 2.0 mm size and size of sample reduced by canning and quartering. A perusal of soil data categorized as sandy loam in texture belongs to order Inceptisol and neutral to alkaline in reaction.

TREATMENT DETAILS:

The experiment was setup in a Randomized block design with three replication and nine treatments. The wheat variety PBW-343 was grown during the two experiment years 2020-2021 and 2021-2022.

List 1 : List of treatment combinations used for the study

TREATMENT	TREATMENT COMBINATIONS
T1	Farmers practice (Farmers practice (80:57:0 NPK kg ha^{-1})
T2	General recommended fertilizer dose (GRD) (120:60:40 NPK kg ha^{-1})

T3	GRD+FYM 5 t ha^{-1} (120:60:40 NPK kg ha^{-1})+FYM 5 t ha^{-1}
T4	GRD+FYM 10 t ha^{-1} (120:60:40 NPK kg ha^{-1})+FYM 10 t ha^{-1}
T5	GRD+FYM 15 t ha^{-1} (120:60:40 NPK kg ha^{-1})+FYM 15 t ha^{-1}
T6	Soil test-based fertilizer dose (STB) (150:15:150 NPK kg ha^{-1})
T7	STB+FYM 5 t ha^{-1} (150:15:150 NPK kg ha^{-1})+FYM 5 t ha^{-1}
T8	STB+FYM 10 t ha^{-1} (150:15:150 NPK kg ha^{-1})+FYM 10 t ha^{-1}
T9	STB+FYM 15 t ha^{-1} (150:15:150 NPK kg ha^{-1})+FYM 15 t ha^{-1}

List 2 : Initial soil status of the experiment field during 2021

Soil characteristics	Soil depth (0-15cm)
Soil pH	7.6
Electrical conductivity(dsm^{-1})	0.63
Organic carbon (%)	0.42

Available nitrogen (kgha^{-1})	94.50
Available phosphorus(kgha^{-1})	31.5
Available potassium(kgha^{-1})	302.4

3.Results and Discussion

Plant height(cm)

STCR-based application of fertilizers and manure leads to the statistically significant variation in plants height at all growth stage (Table 1). It is evident from the data that plant height was increased with increasing levels of NPK with FYM. It clearly shows that the plant height increased with the age of plants, and it was maximum at 120 DAS. In the second year (2021-2022) with treatment (T9) which was 30.66 cm at 30DAS, in treatment(T6) which was 55.22 cm at 60 DAS, in treatment (T8) which was 103.44 cm at 90 DAS and in treatment (T8) which was 107.11cm at120 DAS respectively. Also reported that 125 kg N ha^{-1} significantly increased the plant height (95.2 &96.7 cm) by Chaturvedi (2006). Yadav and Chippa (2005) showed significant increase in plant height by application of FYM up to 30 t ha^{-1}. Kavinder *et al.,* (2019) concluded that, the farm yard manure along with 120 kg N/ha was the best treatment in combination, played a significant role in marking highest pre-harvest observation like plant height. Yugal *et al.,* (2015) observed that plant height of wheat crop was significantly influenced with STCR dose with 5 t FYM. Patel *et al.,* (2017) reported that the plant height of wheat was significantly more under 75% NPK with 10 t FYM/ha as compare the use of recommended dose of NPK.

Soil pH

The lowest pH was observed (7.12) were recorded in treatment T_8((150:15:150 NPK kg ha^{-1} +FYM 10 t ha^{-1}) and (7.17) recorded in treatment T_3(120:60:40 NPK kg ha^{-1} +FYM 5 t ha-$^{-1}$) in 1st year. These results of decrease in soil pH due to addition of FYM (Table 3). The study on soil pH of analysed soil samples varied from 7.12-7.27,7.50-7.60 and 7.35-7.42%, respectively, at 1st year and 2nd year and on pooled basis.

Bhatt *et al.,* (2017) reported the result proclaimed that great significance value among various treatments, focused on when applied with inorganic fertilizers and organic fertilizers, which was significantly value of soil chemical properties like soil pH. Malik and Chaman (2016) the study proclaimed that, among various treatments, soil pH (7.8 - 7.5) of harvested soil sample recorded from the plot receiving 100% NPK was applied through Incorporation of farm yard manure.

Sephya *et al*., (2012) reported that the application of 100% NPK (50% NPK + 50% N Through farmyard manure) to wheat was the best practice than the rest of the treatment for improving the soil properties like pH.

Kumar et al., (2012) indicated that the application of integrated use of organic fertilizer in combination with organic materials facilitates increase in wheat yield and increase in pH.

1000 grains weight(g)

Grain weight of wheat was significantly influenced by different level of fertilizers and manure application based on STCR approach. Maximum grain weight viz.46.66,46.66 and 46.52g was recorded in 1st year (2020-2021) with treatment (T_3), (T_7) and (T_9) respectively (Table 2). Chaturvedi *et al.,* (2006) Reported that 125 kg N ha^{-1} significantly increased the 1000 grain weight (48.1 &49.8 g) of wheat. Yogesh *et al.,* (2007) indicated that the wheat cultivar PBW-343 recorded the highest 1000-grain weight (41.01 g) while cultivar HD-2329 recorded the lowest 1000-grain weight (31.83 g) on sandy loam soil.

Table.1 Effect of STCR-based fertilizers and manure recommendation on plant height of wheat in pooled

Treatment	Treatment combination	Plant height(cm)			
		30DAS	60DAS	90DAS	120DAS
T1	Farmers practice (80:57:0 NPK kg ha^{-1})	24.44	49.44	94.10	104.27
T2	General recommended fertilizer dose (GRD) (120:60:40 NPK kg ha^{-1})	24.49	50.22	95.44	104.16
T3	GRD+FYM 5 t ha^{-1} (120:60:40 NPK kg ha^{-1})+FYM 5 t ha^{-1}	25.82	54.60	98.60	104.38
T4	GRD+FYM 10 t ha^{-1} (120:60:40 NPK kg ha^{-1})+FYM 10 t ha^{-1}	25.72	54.60	96.99	104.10
T5	GRD+FYM 15 t ha^{-1} (120:60:40 NPK kg ha^{-1})+FYM 15 t ha^{-1}	26.22	54.00	96.83	105.44
T6	Soil test-based	26.94	55.61	97.33	106.88

	fertilizer dose (STB) (150:15:150 NPK kg ha^{-1})				
T7	STB+FYM 5 t ha^{-1} (150:15:150 NPK kg ha^{-1})+FYM 5 t ha^{-1}	26.55	53.55	100.05	105.72
T8	STB+FYM 10 t ha^{-1} (150:15:150 NPK kg ha^{-1})+FYM 10 t ha^{-1}	26.99	51.16	99.38	105.38
T9	STB+FYM 15 t ha^{-1} (150:15:150 NPK kg ha^{-1})+FYM 15 t ha^{-1}	26.88	51.10	99.99	105.16
F-test		S	S	S	S
C.D. Value 0.5%		0.51	0.24	0.91	0.68
S.Ed.(±)		1.09	0.50	1.92	1.44

Table.2 Effect of STCR-based fertilizers and manure recommendation on post-harvest soil pH

Treatment	Treatment combination	pH		
		1st year	2nd year	Pooled
T1	Farmers practice (80:57:0 NPK kg ha^{-1})	7.23	7.50	7.36
T2	General recommended fertilizer dose (GRD) (120:60:40 NPK kg ha^{-1})	7.27	7.57	7.42
T3	GRD+FYM 5 t ha^{-1} (120:60:40 NPK kg ha^{-1})+FYM 5 t ha^{-1}	7.17	7.60	7.38
T4	GRD+FYM 10 t ha^{-1} (120:60:40 NPK kg ha^{-1})+FYM 10 t ha^{-1}	7.27	7.57	7.42
T5	GRD+FYM 15 t ha^{-1} (120:60:40 NPK kg ha^{-1})+FYM 15 t ha^{-1}	7.20	7.50	7.35

T6	Soil test-based fertilizer dose (STB) (150:15:150 NPK kg ha^{-1})	7.20	7.50	7.35
T7	STB+FYM 5 t ha^{-1} (150:15:150 NPK kg ha^{-1})+FYM 5 t ha^{-1}	7.21	7.53	7.35
T8	STB+FYM 10 t ha^{-1} (150:15:150 NPK kg ha^{-1})+FYM 10 t ha^{-1}	7.12	7.57	7.42
T9	STB+FYM 15 t ha^{-1} (150:15:150 NPK kg ha^{-1})+FYM 15 t ha^{-1}	7.23	7.53	7.38
F-test		NS	NS	NS
C.D. Value 0.5%		0.13	0.08	0.84
S.Ed.(±)		0.27	0.18	1.78

Table.**3** Effect of STCR-based fertilizers and manure recommendation on grain weight of wheat in pooled

Treatment	Treatment combination	1000 grain weight (g)		
		1st year	2nd year	Pooled
T1	Farmers practice (80:57:0 NPK kg ha^{-1})	45.66	45.46	45.56
T2	General recommended fertilizer dose (GRD) (120:60:40 NPK kg ha^{-1})	45.96	46.20	46.08
T3	GRD+FYM 5 t ha^{-1} (120:60:40 NPK kg ha^{-1})+FYM 5 t ha^{-1}	46.66	46.65	46.65
T4	GRD+FYM 10t ha^{-1} (120:60:40 NPK kg ha^{-1})+FYM 10 t ha^{-1}	46.50	47.11	46.80
T5	GRD+FYM 15 t ha^{-1} (120:60:40 NPK kg ha^{-1})+FYM 15 t ha^{-1}	45.96	46.80	46.38
T6	Soil test-based fertilizer dose (STB) (150:15:150 NPK kg ha^{-1})	46.48	46.91	46.69
T7	STB+FYM 5 t ha^{-1} (150:15:150 NPK kg ha^{-1})+FYM 5 t ha^{-1}	46.66	47.00	46.83
T8	STB+FYM 10 t ha^{-1} (150:15:150 NPK kg ha^{-1})+FYM 10 t ha^{-1}	46.21	46.88	46.54
T9	STB+FYM 15 t ha^{-1} (150:15:150 NPK kg ha^{-1})+FYM 15 t ha^{-1}	46.52	47.01	46.76

F-test		S	S	S
C.D. Value 0.5%		0.19	0.39	0.13
S.Ed.(±)		0.41	0.82	0.29

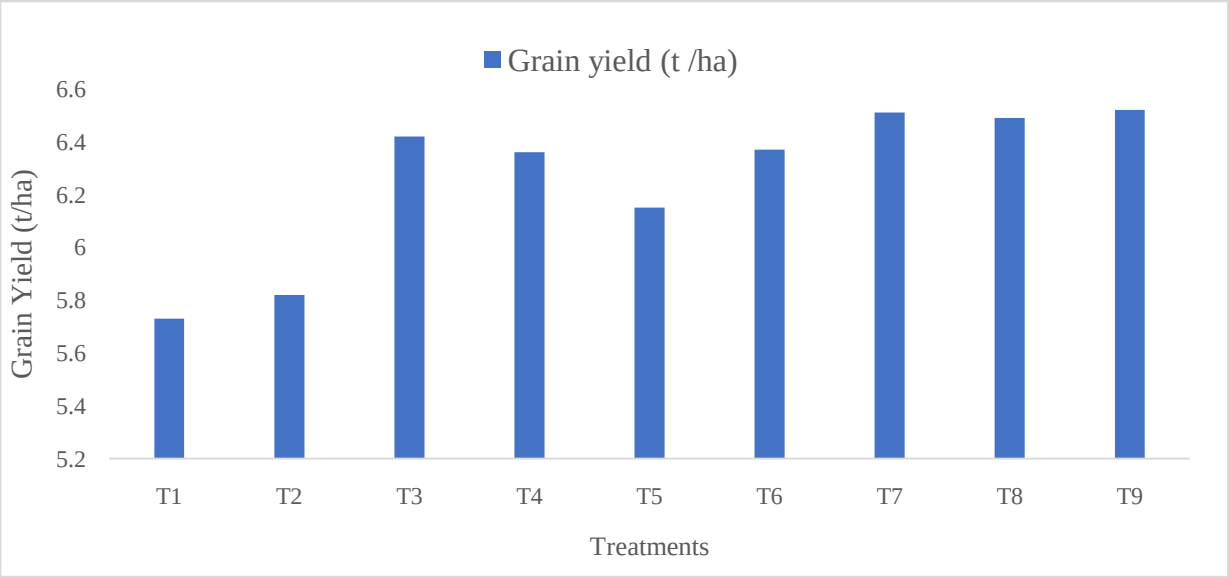

Figure: 1 Effect of STCR-based fertilizers and manure recommendation on grain yield of wheat (2021-22)

4.Conclusion

On the basis of above finding, it is concluded that application of STCR(T9) gave the maximum growth, yield, benefit cost ratio and physical, chemical and nutrient uptake was found best result of wheat. As it is result of on the two years study, it is concluded that prescription-based fertilizer application along with the application of FYM 15tha^{-1} enhanced the soil properties and which will help enhancing yield per unit area for sustaining productivity and fertility of soil.

5.Further Research

The nutrient contribution from fertilizer source along with FYM was greater than that of without FYM. The application of FYM might have played important role in improving phsico-chemical properties and enhance the microbial population and enzyme activity in soil which plays important role in nutrient transformation and availability of nutrients. In addition, carry out long term soil fertility status can be met by choosing green manures and crop residue should be mixed in soil with bio-fertilizers.

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